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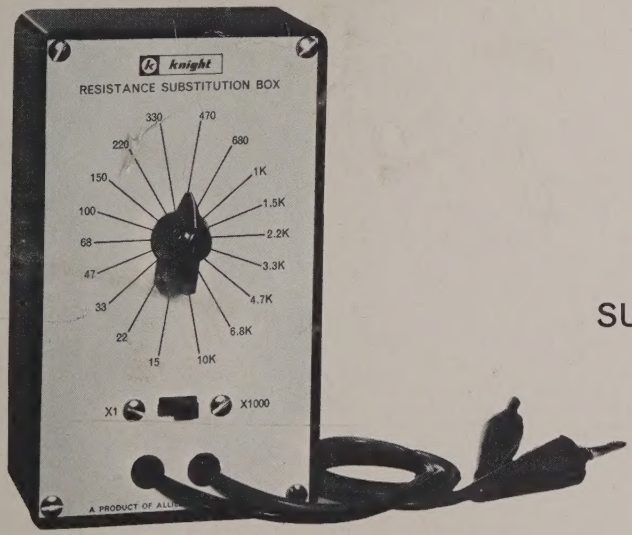


RESISTANCE SUBSTITUTION BOX

83 Y 139

ASSEMBLY MANUAL

knight-kit®

A PRODUCT OF ALLIED RADIO · CHICAGO

THE KNIGHT RESISTANCE SUBSTITUTION BOX

SPECIFICATIONS

RESISTORS

Quantity **36**

Tolerance **10%**

Wattage ..... **1 watt**

RESISTANCE RANGES

Low Range ..... **15 ohms to 10K**

High Range ..... **15K to 10 megohm**

CABINET SIZE

..... **6″ x 3″ x 2″**

INTRODUCTION

The KNIGHT Resistance Substitution Box contains 36 one-watt, 10% resistors and covers a resistance range from 15 ohms to 10 megohms. It is a time saving device for use by engineers, experimenters, and servicemen. The 36 resistors can rapidly be switched into a test circuit one by one to determine an optimum resistance.

CHECKING YOUR KIT

Before starting to build your KNIGHT Resistance Substitution Box, check each part against the Parts List on page 12. If you are unable to identify some of the parts by sight, locate them on the pictorial diagrams.

CONSTRUCTION HINTS

The only tools and materials required for building your KNIGHT Resistance Substitution Box are: Long-nose pliers, diagonal cutters, medium-size screwdriver, setscrew driver, and a soldering iron. A good set of tools is listed at the end of the Parts List.

The proper way to connect a resistor is illustrated in Figure 2. Pull the end leads of the part being mounted through the holes in the mounting terminals so that the part is tightly mounted. After the part is mounted, bend the leads (the wires on the part) around the mounting terminals and cut off the excess wire with your diagonal cutters.

The step-by-step instructions were prepared while a skilled technician was actually building the KNIGHT Resistance Substitution Box. They are the best and fastest way of assembling this unit. We suggest that you check off each step after you have completed it.

THIS KIT MUST BE PROPERLY SOLDERED!

WITHOUT GOOD SOLDERING, AN ELECTRONIC UNIT WILL NOT WORK . . . just as a suit of clothing will fall apart if the stitches are loose . . . no matter how excellent the material.

USE ENOUGH HEAT

This is the main idea of good soldering. The purpose of soldering is to join metal parts, making an UNBROKEN metal path over which electricity can travel. To do this you must apply enough heat to the metal surfaces to make the solder spread freely on them, until the contour (shape) of the connection shows under the solder. If the solder barely melts and forms a rounded ball, *you are not using enough heat.* If you do not use enough heat, there may be no electrical connection, although it appears soldered.

USE A 100-WATT IRON

A 100-watt soldering iron with a clean, chisel-shaped tip will supply the right amount of heat when used correctly. Notice how the iron is held in the picture. Heat the iron for 10 minutes before you start soldering. Keep the tip brightly coated with solder. When necessary, wipe the hot tip clean with a cloth. (If you use a soldering gun, be sure the tip reaches full heat before you solder.)

USE ONLY ROSIN CORE SOLDER

We supply the right kind of solder *(rosin core solder).* Do not use any other kind of solder! USE OF ACID CORE SOLDER, PASTE, OR IRONS CLEANED ON A SAL AMMONIAC BLOCK WILL RUIN ANY ELECTRONIC UNIT AND WILL VOID THE GUARANTEE.

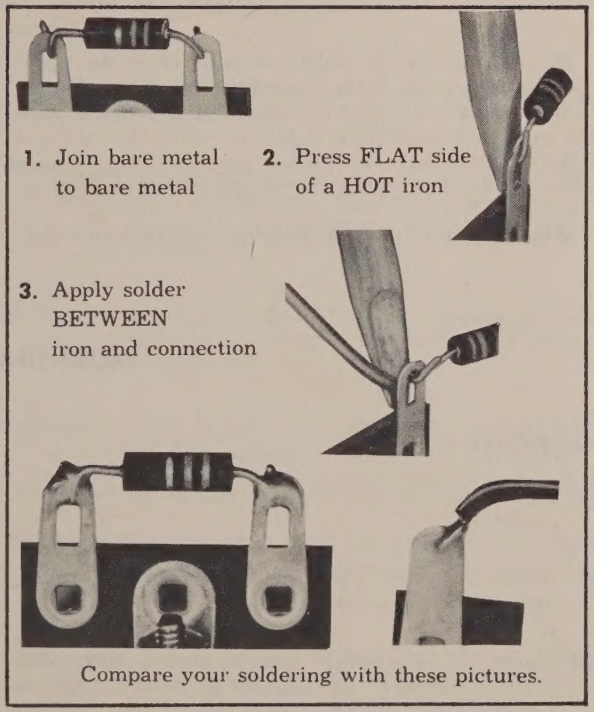
HERE'S HOW TO DO IT . . .

1. Join bare metal to bare metal. Insulation must be removed.
2. Coat the tip of a hot iron with solder.
3. FIRMLY PRESS THE FLAT SIDE OF THE TIP OF A HOT IRON FLAT against the parts to be soldered together. Keep it there while you apply the solder BETWEEN THE IRON TIP AND THE METAL TO BE SOLDERED. Use only enough solder for it to flow over ALL the surfaces of the connection. Remove the iron.
4. DO NOT MOVE PARTS UNTIL THE SOLDER HARDENS. If you accidentally move the wires as the solder is hardening, apply your iron and reheat.

Compare your soldering with the pictures on this page. You have a good connection if your solder has flowed over all surfaces to be connected, following the shape of the surfaces. It should appear smooth and bright.

YOU HAVE NOT USED ENOUGH HEAT: If your connection is rough and flaky-looking, or if the solder has formed a round ball instead of spreading.

The difference between good soldering (enough heat) and poor soldering (not enough heat,) is just a few extra seconds with a hot iron FIRMLY applied. Remember, larger metal surfaces take a longer time to heat.



Compare your soldering with these pictures.

FIGURES 1 AND 2. THE ONE-TWO-THREE OF GOOD SOLDERING

HOW TO CARE FOR YOUR SOLDERING IRON

Before you start to solder, carefully clean the tip of your soldering iron with a fine file, or with steel wool, until the bright metal surface of the tip is exposed. Heat the iron; then cover ("tin") the tip with a thin layer of ROSIN CORE SOLDER. While the iron is hot, remove excess solder from the tip by wiping with a clean cloth.

When the tip of the iron becomes covered with a dull, oxide film, wipe the tip with a clean cloth, and re-tin the iron.

To transfer the full heat of the iron, hold its greatest tip surface to the connection.

Never use the iron like a brush — soldering is not a paste-spreading operation.

MOUNTING THE PARTS

SEE FIGURE 4.

- ☐ Install the two rubber grommets, in the top panel, as shown.
- ☐ Install S-2, the slide switch, and the terminal strip with two screws and nuts.
- ☐ Mount S-1, the rotary switch, with a large lockwasher and nut. See Figure 3. Note: The two wafers nearer the shaft each have a pair of terminals on one side. This side of S-1 is designated as section "A", and must be positioned as shown in Figure 4.

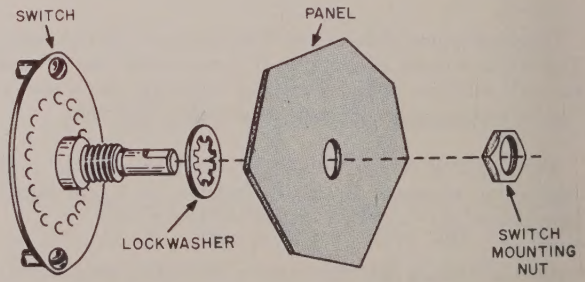


FIGURE 3. HOW TO MOUNT THE SWITCH

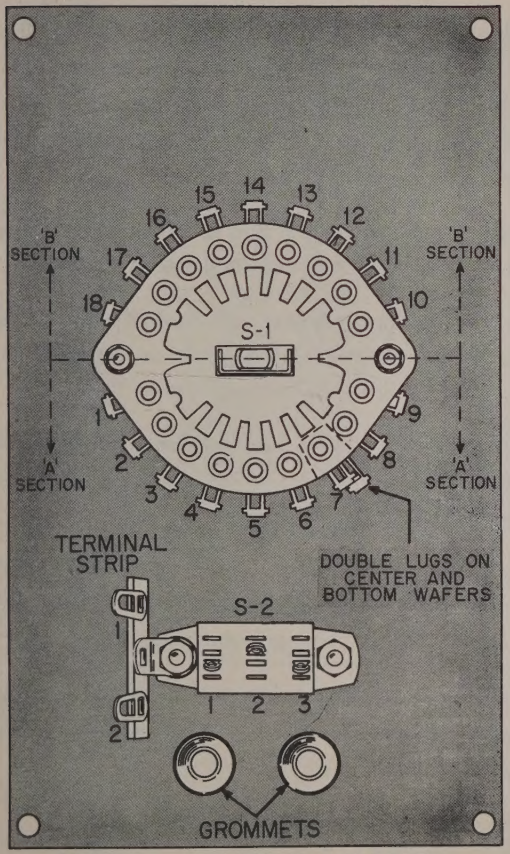


FIGURE 4. MOUNTING THE PARTS

WIRING SECTION "A" OF S-1

SEE FIGURE 5.

Start wiring S-1 with terminal 1 and continue in a counterclockwise direction.

- ☐ Connect but do not solder, one lead of R-19, 15K ohm resistor marked with the color bands brown, green, orange, to terminal 1. Solder the other lead to terminal 19.
- ☐ Solder one lead of R-1, 15 ohm (brown, green, black) resistor, to terminal 1. Solder the other lead to terminal 38.
- ☐ Connect, but do not solder, one lead of R-20, 22K ohm (red, red, orange) resistor, to terminal 2. Solder the other lead to terminal 20.
- ☐ Solder one lead of R-2, 22 ohm (red, red, black) resistor, to terminal 2. Solder the other lead to terminal 39.
- ☐ Connect, but do not solder, one lead of R-21, 33K ohm (orange, orange, orange) resistor, to terminal 3. Solder the other lead to terminal 21.
- ☐ Solder one lead of R-3, 33 ohm (orange, orange, black) resistor, to terminal 3. Solder the other lead to terminal 40.

- [ ] Connect, but do not solder, one lead of R-22, 47K ohm (yellow, violet, orange) resistor, to terminal 4. Solder the other lead to terminal 22.
- [ ] Solder one lead of R-4, 47 ohm (yellow, violet, black) resistor, to terminal 4. Solder the other lead to terminal 41.
- [ ] Connect, but do not solder, one lead of R-23, 68K ohm (blue, gray, orange) resistor, to terminal 5. Solder the other lead to terminal 23.
- [ ] Solder one lead of R-5, 68 ohm (blue, gray, black) resistor, to terminal 5. Solder the other lead to terminal 42.
- [ ] Connect, but do not solder, one lead of R-24, 100K ohm (brown, black, yellow) resistor, to terminal 6. Solder the other lead to terminal 24.
- [ ] Solder one lead of R-6, 100 ohm (brown, black, brown) resistor, to terminal 6. Solder the other lead to terminal 43.
- [ ] Connect, but do not solder, one lead of R-25, 150K ohm (brown, green, yellow) resistor, to terminal 7. Solder the other lead to terminal 26.
- [ ] Solder one end of an orange wire to terminal 25. The other end of this wire will be connected later.
- [ ] Solder one lead of R-7, 150 ohm (brown, green, brown) resistor, to terminal 7. Solder the other lead to terminal 45.
- [ ] Solder one end of a red wire to terminal 44. The other end of this wire will be connected later.
- [ ] Connect, but do not solder, one lead of R-26, 220K ohm (red, red, yellow) resistor, to terminal 8. Solder the other lead to terminal 27.
- [ ] Solder one lead of R-8, 220 ohm (red, red, brown) resistor, to terminal 8. Solder the other lead to terminal 46.
- [ ] Connect, but do not solder, one lead of R-27, 330K ohm (orange, orange, yellow) resistor, to terminal 9. Solder the other lead to terminal 28.
- [ ] Solder one lead of R-9, 330 ohm (orange, orange, brown) resistor, to terminal 9. Solder the other lead to terminal 47.

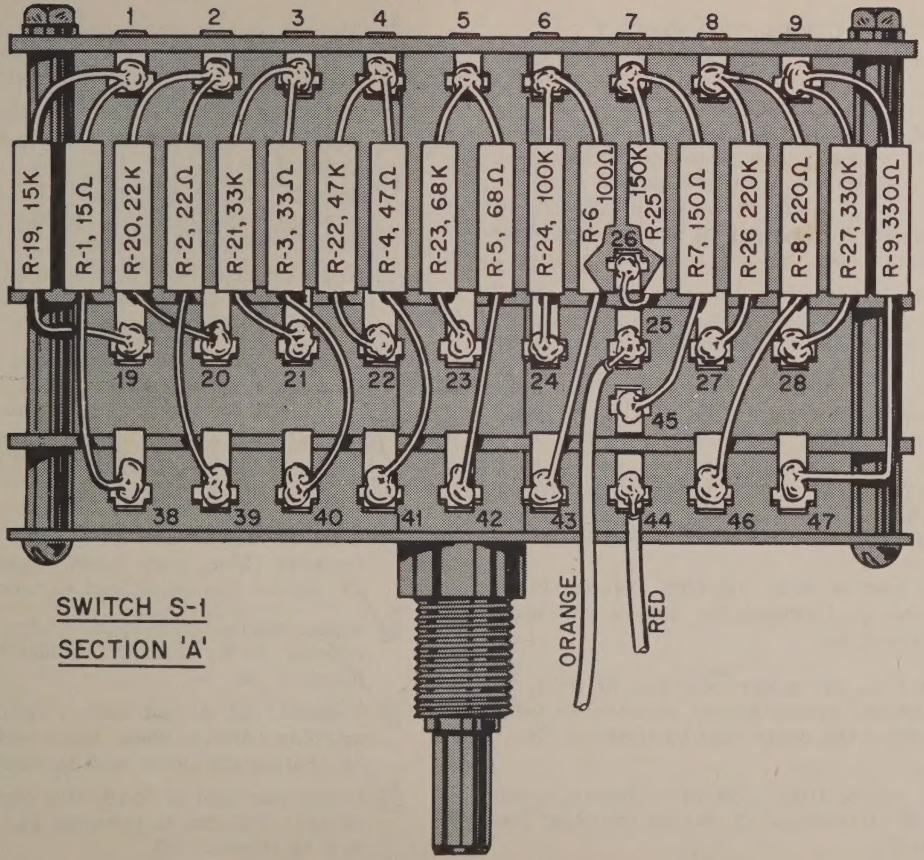


FIGURE 5. WIRING SECTION "A" OF S-1

WIRING SECTION "B" OF S-1

SEE FIGURE 6.

- [ ] Connect, but do not solder, one lead of R-28, 470K ohm (yellow, violet, yellow) resistor, to terminal 10. Solder the other lead to terminal 29.
- [ ] Solder one lead of R-10, 470 ohm (yellow, violet, brown) resistor, to terminal 10. Solder the other lead to terminal 48.
- [ ] Connect, but do not solder, one lead of R-29, 680K ohm (blue, gray, yellow) resistor, to terminal 11. Solder the other lead to terminal 30.
- [ ] Solder one lead of R-11, 680 ohm (blue, gray, brown) resistor, to terminal 11. Solder the other lead to terminal 49.
- [ ] Connect, but do not solder, one lead of R-30, 1 megohm (brown, black, green) resistor, to terminal 12. Solder the other lead to terminal 31.
- [ ] Solder one lead of R-12, 1K ohm (brown, black, red) resistor, to terminal 12. Solder the other lead to terminal 50.
- [ ] Connect, but do not solder, one lead of R-31, 1.5 megohm (brown, green, green) resistor, to terminal 13. Solder the other lead to terminal 32.
- [ ] Solder one lead of R-13, 1.5K ohm (brown, green, red) resistor, to terminal 13. Solder the other lead to terminal 51.
- [ ] Connect, but do not solder, one lead of R-32, 2.2 megohm (red, red, green) resistor, to terminal 14. Solder the other lead to terminal 33.
- [ ] Solder one lead of R-14, 2.2K ohm (red, red, red) resistor, to terminal 14. Solder the other lead to terminal 52.
- [ ] Connect, but do not solder, one lead of R-33, 3.3 megohm (orange, orange, green) resistor, to terminal 15. Solder the other lead to terminal 34.
- [ ] Solder one lead of R-15, 3.3K ohm (orange, orange, red) resistor, to terminal 15. Solder the other lead to terminal 53.
- [ ] Connect, but do not solder, one lead of R-34, 4.7 megohm (yellow, violet, green) resistor, to terminal 16. Solder the other lead to terminal 35.
- [ ] Solder one lead of R-16, 4.7K ohm (yellow, violet, red) resistor, to terminal 16. Solder the other lead to terminal 54.
- [ ] Connect, but do not solder, one lead of R-35, 6.8 megohm (blue, gray, green) resistor, to terminal 17. Solder the other lead to terminal 36.
- [ ] Solder one lead of R-17, 6.8K ohm (blue, gray, red) resistor, to terminal 17. Solder the other lead to terminal 55.
- [ ] Connect, but do not solder, one lead of R-36, 10 megohm (brown, black, blue) resistor, to terminal 18. Solder the other lead to terminal 37.
- [ ] Solder one lead of R-18, 10K ohm (brown, black, orange) resistor, to terminal 18. Solder the other lead to terminal 56.

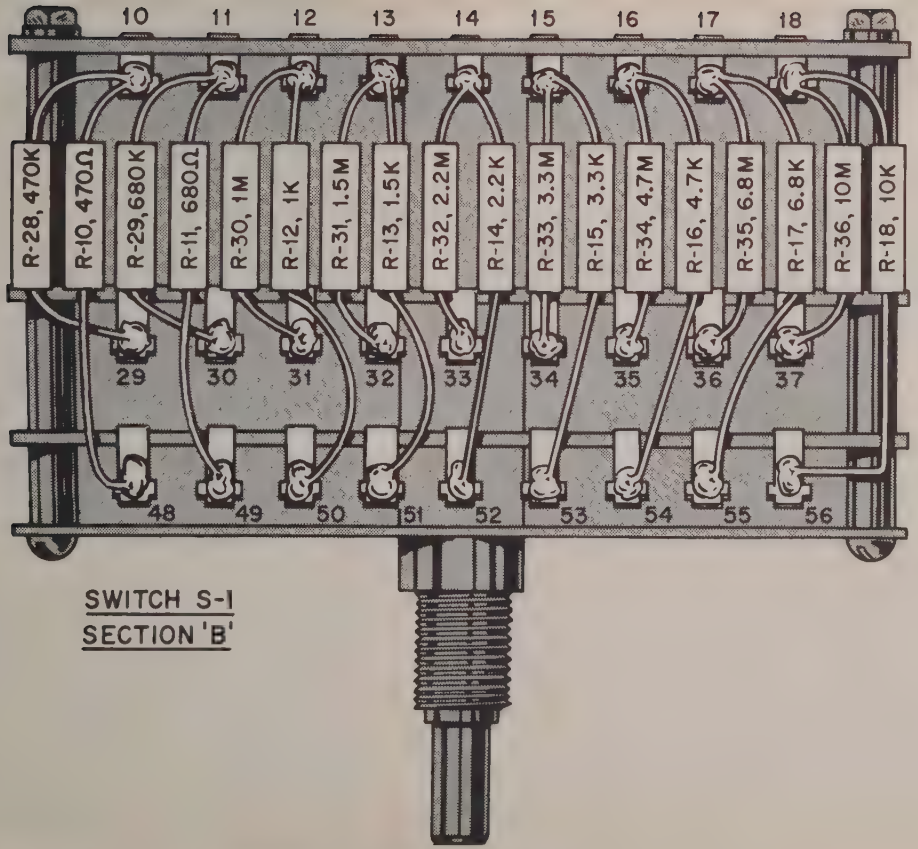


FIGURE 6. WIRING SECTION "B" OF S-1

FINAL WIRING

SEE FIGURE 7.

- [ ] Using the 7″ length of bare wire, string it around and solder it to each of the rivets that hold the terminals to the top wafer of S-1.
- [ ] Solder the free end of the red wire coming from S-1 to terminal 3 on S-2.
- [ ] Solder the free end of the orange wire coming from S-1 to terminal 1 on S-2.
- [ ] Solder one end of a yellow wire to the rivet on S-1 as shown in Figure 7. Connect, but do not solder, the other end to terminal 1 on the terminal strip.
- [ ] Solder one end of a red wire to terminal 2 on S-2. Connect, but do not solder, the other end to terminal 2 on the terminal strip.
- [ ] Remove about ½″ of insulation from both ends of the RED and BLACK test leads.
- [ ] Insert one end of the black test lead through the grommet nearest to the terminal strip. Tie a knot in the lead about 2″ from this end. Then, solder the end of the lead to terminal 1 on the terminal strip.

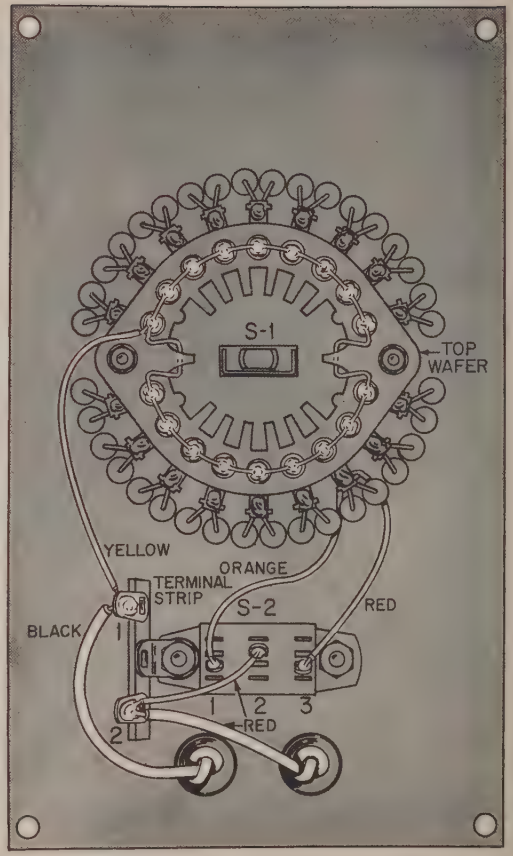


FIGURE 7. FINAL WIRING

Insert the end of the red test lead through the other grommet and tie a knot about 2″ from the end. Solder the end of the lead to terminal 2 on the terminal strip.

Place a black insulator on the other end of the black test lead. Place a red insulator on the other end of the red test lead. Now, attach an alligator clip to each of the test leads. See Figure 8.

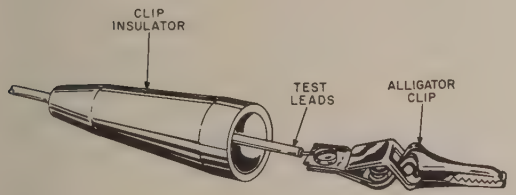


FIGURE 8. TEST LEAD ASSEMBLY

You have now completed all of the wiring steps. Mount the assembled parts in the case with four screws. Place the knob on the shaft of the switch and tighten the setscrew against the flat portion of the shaft.

USING THE KNIGHT RESISTANCE SUBSTITUTION BOX

The range of the KNIGHT Resistance Substitution Box is from 15 ohms to 10 megohms. When the slide switch is in the X1 position, resistances from 15 ohms to 10,000 ohms can be read directly on the scale. Pushing the slide switch to the X1000 position multiplies the resistance reading on the scale by 1000. This means that a 15 reading on the scale now becomes 15,000, a 22 reading is now 22,000, and 1K becomes 1 megohm.

The KNIGHT Resistance Substitution Box is very applicable to experimental work. For instance it may be desired to try several different values of resistance in a circuit to determine a value which will give best results. To use the Resistance Substitution Box, merely clip its leads to the points in the circuit where the leads of a resistor would normally be connected. Occasionally a service technician will make use of the Substitution Box to determine the proper replacement resistor when the original component is charred so badly that its color code markings are not readable. It is best not to use the Resistance Substitution Box in any circuit where the added capacity may detune the circuit. **CAUTION: Do not use the KNIGHT Resistance Substitution Box in circuits where the 1 watt rating of the resistors will be exceeded.**

PARTS LIST

Symbol Number	Description	Allied Part No.
Note:	**When ordering resistors, give part number and description.**	
R-1	Resistor, 15 ohms, 1 watt	304150
R-2	Resistor, 22 ohms, 1 watt	304220
R-3	Resistor, 33 ohms, 1 watt	304330
R-4	Resistor, 47 ohms, 1 watt	304470
R-5	Resistor, 68 ohms, 1 watt	304680
R-6	Resistor, 100 ohms, 1 watt	304101
R-7	Resistor, 150 ohms, 1 watt	304151
R-8	Resistor, 220 ohms, 1 watt	304221
R-9	Resistor, 330 ohms, 1 watt	304331
R-10	Resistor, 470 ohms, 1 watt	304471
R-11	Resistor, 680 ohms, 1 watt	304681
R-12	Resistor, 1000 ohms, 1 watt	304102
R-13	Resistor, 1500 ohms, 1 watt	304152
R-14	Resistor, 2200 ohms, 1 watt	304222
R-15	Resistor, 3300 ohms, 1 watt	304332
R-16	Resistor, 4700 ohms, 1 watt	304472
R-17	Resistor, 6800 ohms, 1 watt	304682
R-18	Resistor, 10,000 ohms, 1 watt	304103
R-19	Resistor, 15,000 ohms, 1 watt	304153
R-20	Resistor, 22,000 ohms, 1 watt	304223
R-21	Resistor, 33,000 ohms, 1 watt	304333
R-22	Resistor, 47,000 ohms, 1 watt	304473
R-23	Resistor, 68,000 ohms, 1 watt	304683
R-24	Resistor, 100,000 ohms, 1 watt	304104
R-25	Resistor, 150,000 ohms, 1 watt	304154
R-26	Resistor, 220,000 ohms, 1 watt	304224
R-27	Resistor, 330,000 ohms, 1 watt	304334
R-28	Resistor, 470,000 ohms, 1 watt	304474
R-29	Resistor, 680,000 ohms, 1 watt	304684
R-30	Resistor, 1 megohm, 1 watt	304105
R-31	Resistor, 1.5 megohm, 1 watt	304155
R-32	Resistor, 2.2 megohm, 1 watt	304225
R-33	Resistor, 3.3 megohm, 1 watt	304335
R-34	Resistor, 4.7 megohm, 1 watt	304475
R-35	Resistor, 6.8 megohm, 1 watt	304685
R-36	Resistor, 10 megohm, 1 watt	304106

Symbol Number	Description	Allied Part No.
S-1	Switch, 2-pole: 18-positions	432303
S-2	Switch, slide: SPDT	431101

Description	Quantity	Allied Part No.
Cabinet	1	701005
Clip, alligator	2	532005
Grommet, rubber	2	830100
Insulator, alligator clip: red	1	880003
Insulator, alligator clip: black	1	880004
Knob, black	1	762201
Lockwasher, 3/8"	1	582700
Nut, hex: 3/8"	1	570840
Nut, hex: 6-32x1/4"	2	570340
Panel, top	1	462619
Screw, machine: 6-32x5/16"	6	560343
Terminal strip	1	440201
Instructions	1	750021
2" Red wire	2	801002
3" Orange wire	1	801003
4" Yellow wire	1	801004
7" Bare wire	1	806007
18" Test lead: red	1	804018
18" Test lead: black	1	804017
24" Solder, rosin core	1	930004

TOOLS YOU MAY NEED

Allied Part No.	Description	Price*
46 N 852	Soldering iron, pencil type	$5.22
50 N 132	Long-nose, side-cutting pliers, 6"	1.82
50 N 133	Diagonal cutters, 5"	1.63
45 N 796	Screwdriver, 6"	.78

* All prices subject to change

Free Information Service

First, write a letter to us if your wired kit does not operate properly. Address KNIGHT-KIT Dept. at Allied Radio. Give the stock number of the kit, date of purchase and describe the problem. In a great many cases our technicians can determine corrective steps from the information in your letter. This free information service may save you the expense and inconvenience of returning the kit for repairs.

Should it appear that work in our shop is necessary, we will send you a pre-addressed label and specific packing instructions for your kit.

Special Inspection Service

You may return this wired KNIGHT-KIT for inspection and repair within one year after purchase for a special service charge of $1.00. An additional charge will be made for any parts damaged in construction or for parts beyond the EIA 90-day warranty period. Service charges for kits returned after the one year period will be based on the length of time needed to repair the unit plus the cost of any parts required.

PLEASE NOTE: KITS SOLDERED WITH ACID CORE SOLDER, PASTE FLUX, OR WITH IRONS CLEANED ON A SAL AMMONIAC BLOCK ARE NOT ELIGIBLE FOR REPAIR OR SERVICE BECAUSE THEY HAVE BEEN PERMANENTLY DAMAGED BY THE ACID FLUX.

Packing Instructions

If you return this kit, pack it well. Do NOT use the original carton—it is too small for the assembled kit. To prevent damage in shipment, use a carton large enough so that cushioning material can be placed around the instrument. Cushion it well and tightly. Mark it: FRAGILE — DELICATE ELECTRONIC EQUIPMENT.

We recommend that this equipment be shipped ONLY by Railway Express, if at all possible, to forestall damage in shipment. Send the kit prepaid and insured. We will return the repaired kit to you C.O.D. as soon as repairs are completed. If you wish to save C.O.D. fees, your advance remittance may be enclosed for standard repair charges plus transportation costs. Any excess remittance will be refunded.

If Your Kit Arrived Damaged

If your kit was damaged in a parcel post shipment, please write us at once, describing the condition in which the shipment was received. If your kit was part of a Railway Express shipment that was damaged in transit, please notify the local Railway Express agent at once and then write us.

KNIGHT-KIT GUARANTEE

Allied extends these firm guarantees on KNIGHT-KITS:

All KNIGHT-KITS are sold with an exclusive money-back guarantee to meet or exceed published specifications and to perform exactly as specified or we refund your money.

In addition, we guarantee that only premium-quality components are selected for use in KNIGHT-KITS. Every KNIGHT-KIT component is fully warranted against defects in material and workmanship for a period of 90 days from date of original purchase. Should replacement parts be required under this warranty, notify us promptly, including sufficient details to identify the required parts. Parts will be shipped prepaid without charge. We reserve the right to request the return of defective parts.

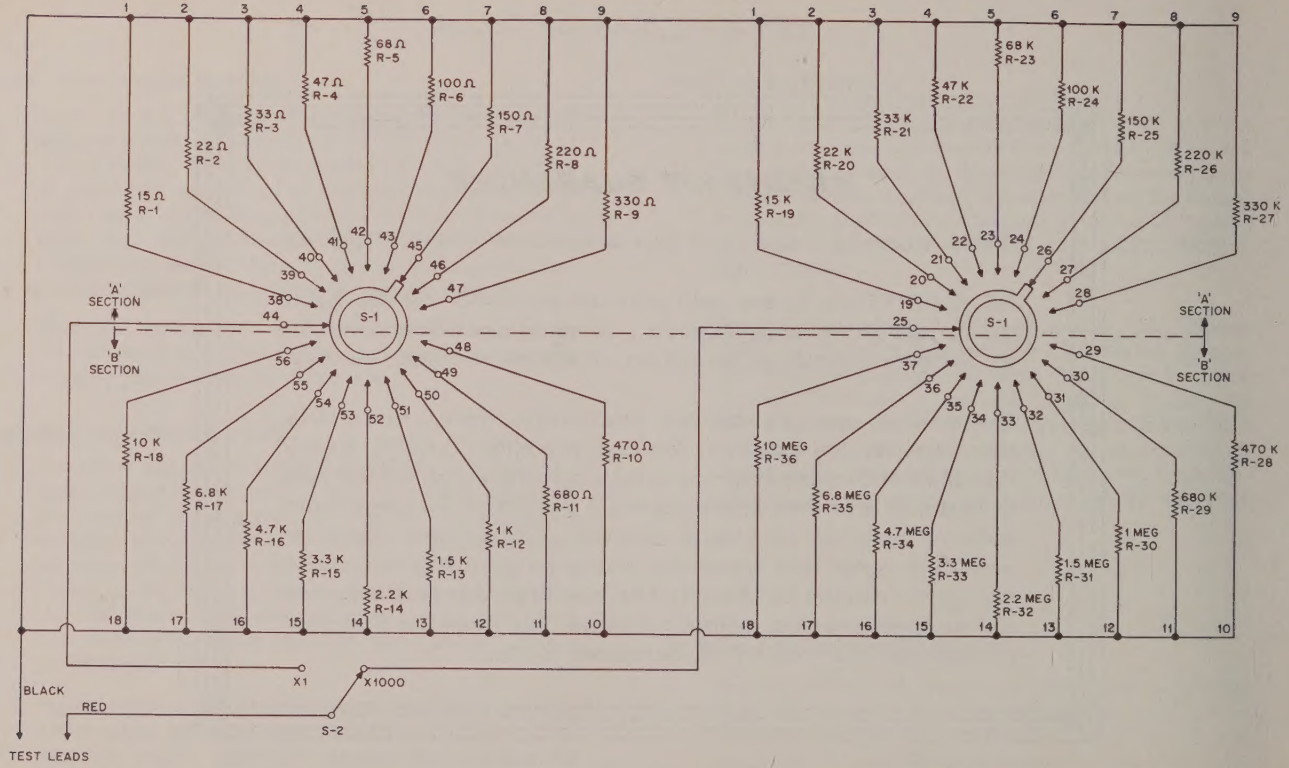


FIGURE 9. SCHEMATIC DIAGRAM

KNIGHT-KITS ARE YOUR BEST BUY THE FINEST ELECTRONIC EQUIPMENT IN KIT FORM. CREATIVE ENGINEERING AND USE OF PREMIUM QUALITY PARTS ASSURE SUPERIOR PERFORMANCE. THAT'S WHY KNIGHT-KITS ARE SOLD WITH THIS EXCLUSIVE GUARANTEE: *EVERY KNIGHT-KIT MUST MEET PUBLISHED SPECIFICATIONS OR WE REFUND YOUR MONEY.*

KNIGHT-KITS ARE "CONVENIENCE ENGINEERED" RESISTORS ARE CARD MOUNTED AND IDENTIFIED. WIRE IS PRECUT. SMALL PARTS ARE PACKAGED IN SEE-THROUGH PLASTIC BAGS. DETAILS SUCH AS THESE AND STEP-BY-STEP INSTRUCTION MANUALS MAKE KNIGHT-KITS EASIEST TO BUILD.

KNIGHT-KITS ARE THE FIRST CHOICE OF EXACTING BUILDERS OF ELECTRONIC KITS EVERYWHERE AND HAVE BEEN SINCE THE EARLY 20's. THERE IS AN OUTSTANDING KNIGHT-KIT AVAILABLE FOR EVERY REQUIREMENT. EACH IS A REWARDING ADVENTURE IN KIT CONSTRUCTION. YOU WILL BE PROUD TO BUILD AND OWN A KNIGHT-KIT.

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